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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte FRANCISCO JUAREZ, DENNIS HAUSMANN, BUNSEN NIE,
TERESA PONG, ADRIANNE TIPTON, and PATRICK VAN CLEEMPUT

Appeal 2009-010801
Application 10/821,092
Technology Center 1700

Decided: September 18, 2009

Before CATHERINE Q. TIMM, ROMULO H. DELMENDO, and
MICHAEL P. COLAIANNI, *Administrative Patent Judges*.

DELMENDO, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants appeal under 35 U.S.C. § 134(a) from a final rejection of claims 1-10 and 20-28 (Appeal Brief filed February 26, 2009, hereinafter “App. Br., 2-3”; Final Office Action mailed October 28, 2008). We have jurisdiction under 35 U.S.C. § 6(b).

We REVERSE.

STATEMENT OF THE CASE

Appellants state that the claimed invention “is directed to a method of depositing material on a substrate . . . [in] a reaction chamber,” which includes, *inter alia*, a step of “enlarging the reaction chamber to a second, larger volume and removing undeposited first precursor and any excess reaction product to end reaction of the first precursor with the substrate” (Specification, hereinafter “Spec.,” ¶ [0013]).

Claims 1 and 8, the only independent claims, read as follows:

1. A method of depositing material on a substrate comprising:
 - providing a reactor with a reaction chamber having a first volume;
 - securing a substrate within the reaction chamber;
 - introducing a first precursor into the reaction chamber at the first chamber volume;
 - contacting a surface of the substrate in the reaction chamber with the first precursor at the first chamber volume to cause a reaction of the first precursor with and deposit a first layer on the substrate; and
 - enlarging the reaction chamber to a second, larger volume to reduce concentration of the first precursor and removing undeposited first precursor to end reaction of the first precursor.
8. A method of depositing a film on a substrate comprising:

providing a reactor with a reaction chamber, the reaction chamber including a pedestal adapted to secure a substrate during the deposition and movable within the chamber between an upper position and a lower position, the reaction chamber having a first volume when the pedestal is in the upper position and a second, larger volume when the pedestal is in the lower position;

securing a substrate on the pedestal;

introducing a first precursor into the reaction chamber when the substrate is on the pedestal is in the upper position at the first chamber volume;

contacting a surface of the substrate in the reaction chamber with the first precursor at the first chamber volume to cause a reaction of the first precursor with and deposit a first layer on the substrate;

lowering the pedestal to the lower position to enlarge the reaction chamber to the second, larger volume to reduce concentration of the first precursor and removing undeposited first precursor to end reaction of the first precursor;

raising the pedestal to the upper position to reduce the reaction chamber to the first chamber volume;

introducing a second precursor into the reaction chamber when the substrate is on the pedestal is in the upper position at the first chamber volume;

contacting the first layer in the reaction chamber with the second precursor at the first chamber volume to cause a reaction of the second precursor with and deposit a second layer on the first layer, thereby forming a film; and

lowering the pedestal to the lower position to enlarge the reaction chamber to the second volume to reduce concentration of the second precursor and removing undeposited second precursor to end reaction of the second precursor.

(App. Br. 11 and 13-14; Claims App'x.)

The Examiner relies upon the following as evidence of unpatentability
(Examiner's Answer mailed April 15, 2009, hereinafter "Ans.," 3):

Santiago ¹	6,716,287 B1	Apr. 6, 2004
Luo ²	2003/0059535 A1	Mar. 27, 2003

The Examiner rejects claims 1-10 and 20-28 under 35 U.S.C. § 103(a) as unpatentable over the combined teachings of Santiago and Luo (Ans. 3-6).

ISSUES

With respect to the step of “enlarging the reaction chamber to a second, larger volume to reduce concentration of the first precursor and removing undeposited first precursor to end reaction of the first precursor” recited in claim 1, the Examiner asserts, *inter alia*, that Santiago (at col. 3, ll. 8-24 and 53-65) teaches “lowering [a substrate] pedestal to facilitate removal of the substrate while removing undeposited first gas from the chamber to end deposition” (Ans. 4). Furthermore, the Examiner states that “it would have been obvious to a person having ordinary skill in the art . . . to have combined the apparatus of [Santiago] with the technique of [Luo]” because: (i) both references teach depositing material on a substrate; (ii) Luo teaches that “controlling chamber pressure can control the thickness of the deposited layers”; and (iii) Santiago “teaches a means of controlling the chamber pressure by raising and lowering the pedestal” (Ans. 4). The Examiner relies on the same or similar reasoning with respect to claim 8 (Ans. 5).

¹ The Examiner and Appellants refer to Santiago as “‘287” and “Santiago ‘287,” respectively.

² The Examiner and Appellants refer to Luo as “‘535” and “Luo ‘535,” respectively.

Appellants, on the other hand, argue that Santiago “discloses no process in which a precursor remains in the reaction chamber as the support assembly is lowered” (App. Br. 7). According to Appellants, “[i]t is sheer conjecture that Santiago . . . inherently performs or teaches any change in chamber volume while the reaction of a precursor is still depositing a layer on a substrate” (Reply Br. 3). Additionally, Appellants urge that “there is no pressure control means taught by Santiago . . .” (Reply Br. 1-2).

Thus, the issues arising from the contentions of the Examiner and Appellants are:

Have Appellants shown reversible error in the Examiner’s finding that Santiago teaches “lowering the pedestal to facilitate removal of the substrate while removing undeposited first gas from the chamber to end deposition” (Ans. 4)?

Have Appellants shown reversible error in the Examiner’s finding that Santiago “teaches a means of controlling the chamber pressure by raising and lowering the pedestal” (Ans. 4)?

FINDINGS OF FACT ("FF")

- Santiago's Figures 1-3 are reproduced below:

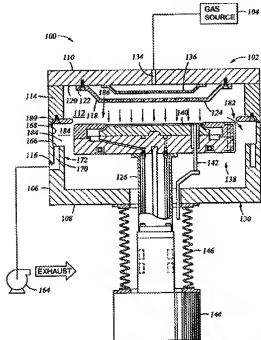


Fig. 1

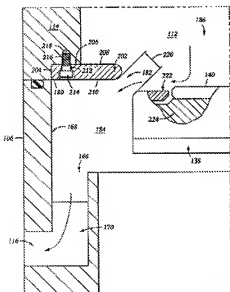


Fig. 2

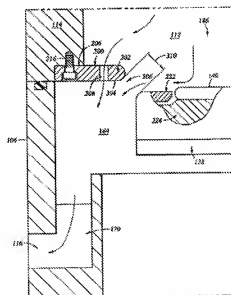


Fig. 3

Figures 1-3 are said to depict embodiments of a processing chamber for chemical vapor deposition (CVD) having, *inter alia*, a flow-restricting ring 180 disposed therein (col. 3, ll. 9-10; col. 2, ll. 50-59), wherein element 138 is a substrate support assembly coupled to a lift mechanism 144 by a shaft 126 (col. 3, ll. 56-58) and is disposed at a distance (220, fig. 2; 310, fig. 3) from the ring to form an orifice (182, fig. 2; 306, fig. 3) between a processing region 186 and an annular pumping plenum 184 (col. 4, l. 20 to col. 5, l. 3).

2. Santiago discloses that “the annular pumping plenum 184 . . . provides a sufficient volume having high conductance between the pumping channel 170 and the orifice 182 to draw flow uniformly through the orifice 182 from the processing volume 120” and that “[t]he uniform flow across the circumference of the orifice 182 results in radial uniformity of process gas flow across the surface of the substrate 140, thereby enhancing substrate processing” (col. 4, ll. 12-19; figs. 1 and 2).
3. Santiago discloses that “the sectional area of . . . holes 308 provides repeatable flow control between the showerhead 118 and the exhaust port 116” (col. 4, ll. 62-64; figs. 1 and 3).
4. Santiago discloses (col. 3, ll. 8-24):

FIG. 1 is a cross-sectional view of one embodiment of a chemical vapor deposition system 100. The system 100 generally includes a chamber body 130 coupled to at least one gas source 104. The chamber body 130 has walls 106, a bottom 108 and a lid assembly 10 that define a process volume 112 . . . An exhaust port 116 is disposed through the walls 106 and couples the pumping

channel 170 to a pumping system 164 that facilitates evacuating gases from the interior volume 112 of the chamber body.

5. Santiago teaches (col. 3, ll. 53-65):

A support assembly 138 is disposed beneath the showerhead 118 . . . The support assembly 138 is coupled to a lift mechanism 144 by a shaft 126. The lift mechanism 144 enables the support assembly 138 to be moved between an upper position proximate the showerhead 118 as shown in Fig. 1 and a lower position that facilitates substrate transfer between the support assembly 138 and a robot (not shown)”

6. Santiago’s claim 10 recites, in relevant part, “an annular ring extending into the interior volume providing a flow restriction between the inlet and exhaust port, the annular ring having an inner end disposed proximate to and radially outward of the substrate support assembly.”
7. Santiago’s Figure 4 is reproduced below:

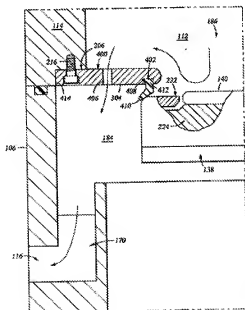


Fig. 4

Figure 4 is said to depict another embodiment of a flow-restricting ring (col. 2, ll. 58-59), wherein seal 402 substantially prevents gas flow between a ring 400 and the substrate support assembly 138 and therefore “all of the flow entering the process volume 112 must flow through a plurality of holes 406 . . . formed through the ring 400 . . . before being drawn out the exhaust port 116” (col. 5, ll. 11-17).

PRINCIPLES OF LAW

“Section 103 forbids issuance of a patent when ‘the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.’” *KSR Int’l Co. v. Teleflex, Inc.*, 550 U.S. 398, 406 (2007).

While *KSR* explains that an obviousness “analysis need not seek out precise [prior art] teachings,” it nonetheless did not dispense with the need for evaluating the evidence to determine whether a person having ordinary skill in the art would have had “an apparent reason to combine the known elements in the fashion claimed.” *Id.* at 418.

ANALYSIS

We agree with Appellants that the Examiner’s rejection is not well founded. The Examiner believes that Santiago (at column 3, lines 8-24 and 53-65) teaches “lowering the pedestal [support assembly 138] to facilitate removal of the substrate *while removing undeposited first gas from the*

chamber to end deposition” (emphasis added; Ans. 4). It does not. Instead, Santiago merely states that the support assembly 138 is lowered to facilitate “substrate transfer between the support assembly 138 and a robot (not shown)” (FF 1, 4, and 5). Nothing substantiates the Examiner’s belief that Santiago teaches lowering the support assembly 138 *during* deposition or that a person of ordinary skill in the art would have been led to do so.

Realizing the weakness in the reliance on Santiago’s disclosure at column 3, lines 8-24 and 53-65, the Examiner further relies on Santiago’s claim 10 (Ans. 6). Specifically, the Examiner speculates that “when th[e] substrate support [of Santiago’s claim 10] is in the fully raised position, it contacts the flow-restricting ring to form a gas seal” (Ans. 6) and, therefore, “the only way to remove the unreacted first reactive gas from the chamber is to lower the pedestal” (*id.* at 7). Again, however, the Examiner’s reasoning is based on speculation rather than facts. Santiago’s claim 10 does not disclose or otherwise suggest that substrate support assembly contacts the flow-restricting ring to form a gas seal (FF 6). Nor does it disclose or otherwise suggest venting unreacted gas during deposition (FF 6). Indeed, the totality of Santiago’s disclosure indicates otherwise. For example, Figures 2 and 3 show an orifice between the flow-restricting ring and the substrate support assembly that provides flow between the inlet and exhaust ports to enhance substrate processing (FF 1-3). As pointed out by Appellants, Santiago teaches that precursor gases introduced into the processing region 186 are removed by the vacuum system either through orifice 182 (Figures 1 and 2), orifice 306 and holes 308 (Figure 3), or holes 406 (Figure 4) (FF 1-3 and 7; Reply Br. 2).

We also find no factual basis in the Examiner's finding that Santiago "teaches a means of controlling the chamber pressure by raising and lowering the pedestal" (Ans. 4). The Examiner has not provided sufficient evidence or technical reasoning to show that raising or lowering Santiago's substrate support pedestal would necessarily increase or decrease pressure in the reaction chamber for any purpose, let alone the purpose disclosed in Luo (to control the thickness of the deposition).

For these reasons, the Examiner has failed to establish that one of ordinary skill in the art would have had any reason to modify Santiago's method to include a step of "enlarging the reaction chamber to a second, larger volume to reduce concentration of the first precursor and removing undeposited first precursor to end reaction of the first precursor," as recited in claim 1, or "lowering the pedestal to the lower position to enlarge the reaction chamber to the second, larger volume to reduce concentration of the first precursor and removing undeposited first precursor to end reaction of the first precursor," as recited in claim 8.

CONCLUSION

Appellants have shown reversible error in the Examiner's finding that Santiago teaches "lowering the pedestal to facilitate removal of the substrate while removing undeposited first gas from the chamber to end deposition" (Ans. 4).

Appellants have also shown reversible error in the Examiner's finding that Santiago "teaches a means of controlling the chamber pressure by raising and lowering the pedestal" (Ans. 4).

DECISION

The Examiner's decision to reject appealed claims 1-10 and 20-28 under 35 U.S.C. § 103(a) as unpatentable over Santiago and Luo is reversed.

REVERSED

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